Updates to AC 20-107B
“Composite Aircraft Structure”

Presented to: Composite Damage Tolerance & Maintenance Workshop (Tokyo)

By: Larry Ilcewicz & Lester Cheng (FAA)
    Simon Waite (EASA)

Date: June 5, 2009
Updates to AC 20-107B
“Composite Aircraft Structure”

• Background: AC 20-107A (Apr 25, 1984)

• CS&CI (Program Support & Technical Basis)

• AC 20-107A Update (AC 20-107B – Joint Effort)
Updates to AC 20-107B
“Composite Aircraft Structure”

• **Background: AC 20-107A (Apr 25, 1984)**
  - Agreement of Development Group
  - Need for AC 20-107A Update
  - Gatwick Meeting (Mar/2003)
  - AC 20-107A vs. Existing Cert. Practices
  - Reasons for AC 20-107A Updates
Agreement - ASC/AECMA Specialists Group on Draft AC 20-107A “Composite Aircraft Structure”

5. It is agreed by all that this joint effort has been mutually beneficial, that this level of cooperation should be considered in other technical areas, and that this group should be reconstituted in no more than five years to update the guidance material to reflect technology developments.

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Composite Damage Tolerance & Maintenance Workshop  
Tokyo, Japan (June 5, 2009)
Need for AC 20-107A Updates

- Inputs collected from certification projects (20+ years) (Noted by FAA Directorates)
- Continued evolvement of composite technology
- Gatwick Meeting (March 2003) - Understanding
- FAA Composite Safety & Certification Initiatives (CS&CI) developed more definitive guidance
Gatwick Meeting - Goals

CAA (Gatwick, UK) Meeting (March 20 & 21, 2003)

- To review individual perspectives and experiences on guidance in AC 20-107A and the associated ACJ 25.603
- To discuss strategies for future change and updates to AC 20-107A and the associated ACJ 25.603
- To discuss other composite guidance needs and joint efforts for development, including collaborative research efforts
Gatwick Meeting – Participants

CAA (Gatwick, UK) Meeting (March 20 & 21, 2003)

- CAA (UK)
  - John Bristow
  - Simon Waite
  - Richard Minter

- CEAT (French, JAA Composite Specialist)
  - Jean Rouchon

- ENAC (Italian)
  - Bruno Moitre

- FAA (US)
  - Larry Ilcewicz
• All participants agreed on a need for revision
  – Harmonization with ACJ 25.603
    (AMC Notes 1 and 2 to CS 25.603)
  – Remove obsolete guidance
  – Working groups for key technical areas should
    include industry and regulatory composite experts

• Strategy to retain this AC material (and associated
  updates) as “general composite guidance”
  – Agree that other more definitive guidance is
    also needed as industry standards evolve
Gatwick Meeting – Understanding (cont.)

CAA (Gatwick, UK) Meeting (March 20 & 21, 2003)

- Key technical areas that need update or change
  - Damage tolerance (impact scenarios, composite/metal interface, scatter factors, fatigue spectra, test substantiation, product types)
  - Environmental conditioning & test substantiation
  - Structural bonding (weak bond issues)
  - Maintenance, inspection and repair
  - Flammability & crashworthiness
  - Recognize new materials and manufacturing processes
  - Composite specialist training needs
  - More definitive guidance is also needed in above areas

- Gatwick inputs were initial basis for FAA current plans

Copy of March 2003 Meeting Minutes are available from L. Ilcewicz upon request
AC 20-107A vs. Existing Certification Practices

• Much of AC 20-107A is still valid
  – Benchmark for general composite guidance
  – More definitive guidance has been developed to fill needs (for aircraft types and specific technical issues)
  – It contains some complex/difficult wording for new users

• Service safety problems and/or certification experiences have not forced a need for change
  – No accidents or industry groups have suggested a need for change or update
  – General nature of the document has not constrained the industry in pursuit of new technology
AC 20-107A vs. Existing Certification Practices (cont.)

• Relevance to transport aircraft (Part 25) versus other aircraft types (Parts 23, 27, 29)
  – AC 20-107A is intended to be valid for all aircraft
  – ACJ 25.603 implies transport aircraft

• 1998 report by White House Commission on Aviation Safety & Security (Gore Commission)
  – Regulatory & guidance material should be performance based
  – Implies different safety levels will be needed for different categories of aircraft

  *Larry retained Joe Soderquist’s “Library” (thorough, step by step records of developing AC 20-107A)*
Reasons for Updates/Changes to AC 20-107A (& ACJ 25.603)

- Remove obsolete guidance
- Change for harmonization
- Update based on service and/or certification experiences
- Additions or changes for new technology (materials, processes, engineering methods, maintenance procedures)
Updates to AC 20-107B
“Composite Aircraft Structure”

• FAA Composite Safety & Certification Initiatives (CS&CI)
  - Program Objectives
  - CS&CI – Milestones Achieved
  - Building Basis for AC 20-107A Updates (2007)
FAA Composite Safety and Certification Initiatives (CS&CI)

• Actively working with industry since 1999

Objectives

1) Work with industry, other government agencies, and academia to ensure safe and efficient deployment of composite technologies used in existing and future aircraft

2) Update policies, advisory circulars, training, and detailed background used to support standardized composite practices

• Safety management (airworthiness) Task Groups initiated within composite standards organizations
CS&CI - Milestone Achieved

• Policy/training for base **material qualification & equivalency** testing for shared databases (update 2003)*
• Policy/training for **static strength substantiation** (2001)
• New rule & AC for **damage tolerance & fatigue evaluation of composite rotorcraft structure** (2002, 2005 & 2009 releases)
• AC for **material procurement & process specs** (2003)*
• Technical document on **composite certification roadmap** (2003)

* FAA Technical Center reports exist for detailed background on engineering practices
CS&CI - Milestone Achieved

- Policy on substantiation of secondary structures (2005)
- Policy for bonded joints & structures was released (2005)*
- Composite maintenance & repair awareness training (2008)*
- Support of CMH-17 (since 1999)
  - New CMH-17 V3/C3: Aircraft Structure Certification and Compliance
  - Updates to CMH-17 V3, C 12-14 in areas of DT & Maintenance
  - CMH-17 tutorials initiated in 2007

* FAA Technical Center reports exist for detailed background on engineering practices
Composite Damage Tolerance & Maintenance Workshop
Tokyo, Japan (June 5, 2009)

FAA CS&CI Steps to Build Basis for AC 20-107A Updates (2007)

• June 2007 Ottawa Meeting
  – FAA, TCCA and EASA presentations
  – Canadian industry review and recommendations

• August 2007 Chicago Meeting
  – FAA draft outline updates

• Initiated Internal FAA Development Team in Fall, 2007
  – Including, plans for associated FAA Clearance Record Process
  – Outlined plan for international harmonization

• Summarized inputs collected over time as a “Detailed Outline for AC 20-107A Updates”
  – Reviewed for completeness by selected individuals prior to Nov. 2007 CACRC Meeting (John Halpin, Mike Borgman, Bjorn Backman)

• November 2007 SAE CACRC Meeting
  – Follow-up discussions and meetings with industry
Updates to AC 20-107B
“Composite Aircraft Structure”

• AC 20-107A Update (AC 20-107B)
  - Biz Plan & Key Milestones
  - A Joint Effort of Global Community
  - Outline of AC 20-107B
  - Contents for Paragraphs
    ^ Para. 1-5 (Non-Technical)
    ^ Para. 6-11 (Technical)
    ^ Appendix 1-3

Contents of Special Interest – Para. 8 & 10
[Further Discussion – Q&A Session]
AC 20-107A Update (AC 20-107B)


- Key Milestones
  - FAA Internal Review – Fall 2008
  - Public Commenting – Spring 2009
  - Final Issuance – September 2009
AC 20-107A Update (AC 20-107B)

- A Joint Effort of Global Community

  ^ FAA Development Team Meeting (Seattle, Dec/07)
  ^ FAA/EASA/TCCA/LBA Meeting (Cologne, Apr/08)
  ^ FAA/EASA/TCCA/LBA Meeting (Seattle, Jun/08)
  ^ Interactions with Industry
    (CMH-17 Meetings – Cocoa Beach, Ottawa & Salt Lake City)
    (CACRC Meetings – Wichita, Athens & Minneapolis)
    (EASA-Industry Meeting – Cologne)
Draft AC 20-107B Outline

1. Purpose of this AC
2. To Whom this AC Applies
3. Cancellation
4. Related Regulations and Relevant Guidance
5. General
6. Material and Fabrication Development
7. Proof of Structure – Static
8. Proof of Structure – Fatigue and Damage Tolerance
9. Proof of Structure – Flutter and Other Aeroelastic Instabilities
10. Continued Airworthiness
11. Additional Considerations

Appendix 1
Appendix 2
Appendix 3

AC 20-107A 11 pages
AC 20-107B 36 pages
(new sections highlighted by blue)
AC 20-107B
Para. 1 thru 5 (Non-Technical)

Para. 1: Purpose of this AC
  – Retains link with Parts 23, 25, 27 and 29 type certification requirements

Para. 2: To Whom this AC Applies
  – An AC Requirement

Para. 3: Cancellation
  – AC 20-107A, dated April 25, 1984 will be cancelled

Para. 4: Related Regulations and Guidance
  – (Link to Appendix 1)

Para. 5: General
  – Rationale for periodic updates (evolution of composite technology, data from service experiences and expanding applications)
  – Thoughts of overall objective is to achieve equivalent or higher levels of safety to metals technology
AC 20-107B
Para. 6: Material & Fabrication Development

- New subsection on material & process control
  (qualification, testing, equivalency sampling, references to other policy & AC)
- New subsection on manufacturing implementation
- New subsection on structural bonding
  - Qualified materials and bonding processes (e.g., surface prep)
  - Critical bonding process steps to control
  - Review of options to ensure structural integrity of bonds
    i) structural redundancy  ii) proof testing  iii) advanced NDE
  - Action for adhesion failures noted in qualification tests or service
- Added thoughts on environmental durability testing
- Design values using parts from mature processes

Content increased from 0.5 to 4.5 pages
AC 20-107B
Para. 7: Proof of Structure - Static

• Added thoughts on the necessary test experience for analysis validation
• Guidance on use of overload factors
• Use of analysis to identify critical load cases and associated failure modes
• Demonstration of fatigue insensitivity with ultimate load test following lifetime reliability testing with structure

Figure A. Schematic diagram of building block tests for a fixed wing.
AC 20-107B
Para. 8: Proof of Structure – Fatigue & DT

- Guidance for damage threat assessment
  - Impact surveys with configured structure
  - Very few impact standards

- Introduced five categories of damage
  - Equivalent levels of safety to metallic DT
  - Inspection interval dependent on damage size (residual strength)

- Promotes fail safety
- RS = f (environment, scatter)

- Justify LEF based on data
- DT Inspection & retirement

Content increased from 1 to 8 pages

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• Para. 9: Proof of Structure–Flutter & Other Aero instability
  – Need to consider significant levels of damage (categories 3 and 4) on control surfaces and secondary structures that affect aero stability

• Para. 10: Continued Airworthiness (new para.)  2.5 pages
  10c. Substantiation of Repair (detection, inspection & repair)
  10d. Damage Detection, Inspection and Repair Competency

• Para. 11: Additional Considerations  Content increased from 1.25 to 5 pages
  11a. Crashworthiness
  11b. Fire Protection, Flammability and Thermal Issues
  11c. Lightning Protection
AC 20-107B

Appendices 1 thru 3

Appendix 1: Applicable Regulations and Relevant Guidance
1. Applicable Regulations [Table]
2. Guidance: [List of AC and PS]

Appendix 2: Definitions
Purpose is to include any terms used in AC 20-107B that may cause confusion for readers.

Appendix 3: Change in Composite Material and/or Process
- Update to EASA AMC No. 2 to 25.603 [3.75 pages]
- Guidance on testing needed for major material & process changes
Milestones: AC 20-107B Development

- FAA Clearance Record Process [Completed]

  AC 20-107B Draft Posted -
  FAA website: [http://www.faa.gov/aircraft/draft_docs/](http://www.faa.gov/aircraft/draft_docs/)
  Send Comments to Lester Cheng: lester.cheng@faa.gov

- Final Issuance [9/09]

  [EASA AMC Plan – To Be Shared by Dr. Waite]

Composite Damage Tolerance & Maintenance Workshop
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Extended Hereby Are Our Thanks To:

- All Regulatory Agencies Participating in the Development of this AC 20-107B.

- All Industry Partners Providing their Thoughts Enhancing the Contents of this AC.

- All Individuals Sharing their Wisdom of Bettering the Value of this AC.
Updates to AC 20-107B
“Composite Aircraft Structure”

May We Entertain A Few Questions?

Larry Ilcewicz (FAA)
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Lester Cheng (FAA)